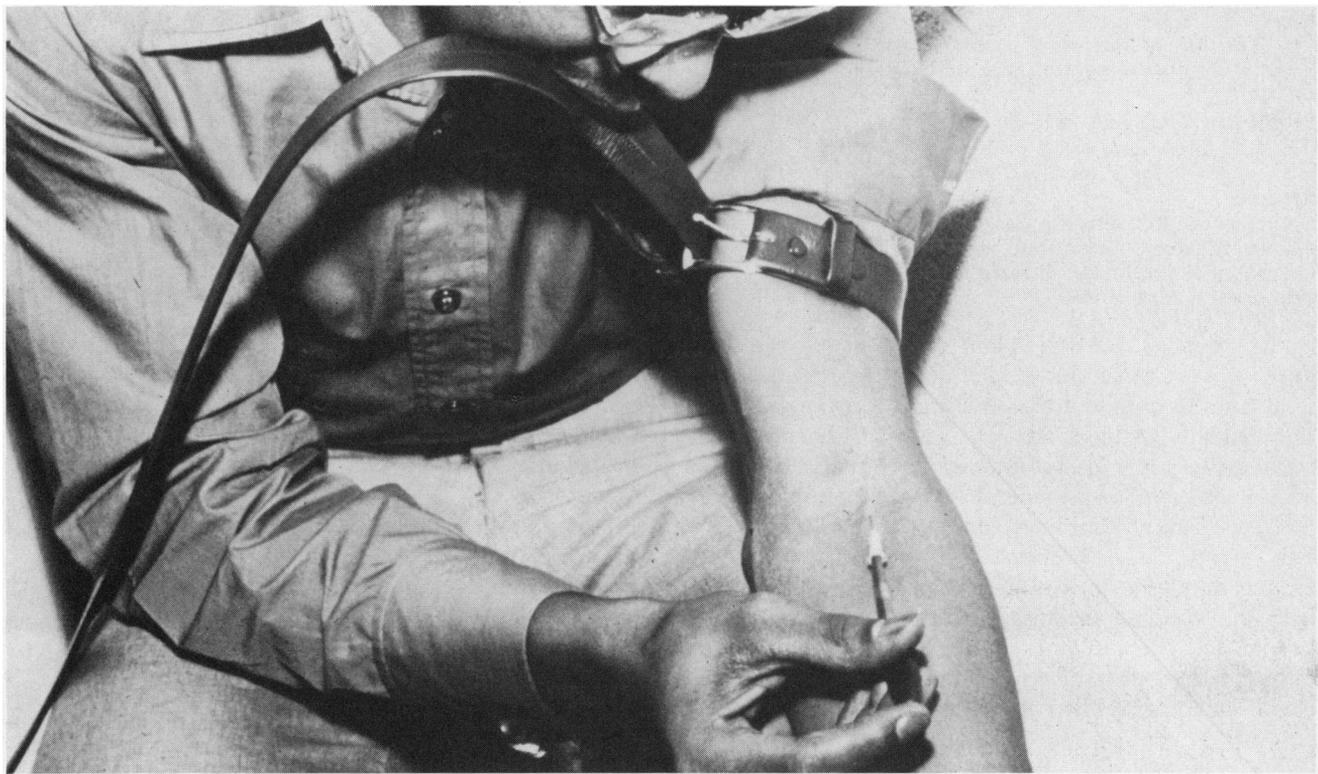


The Drug Abuse Warning Network: A Statistical Perspective

PHILIP H. PERSON, Jr., PhD



THE DRUG ABUSE WARNING NETWORK (DAWN) is a large-scale data-collecting system sponsored jointly by the National Institute on Drug Abuse, Department of Health, Education, and Welfare, and the Drug Enforcement Administration, Department of Justice. The purposes of the project, as formally stated (1a), are to provide for:

1. Identification of drugs currently abused and/or associated with harm to the individual and society.

2. The determination of existing patterns of drug abuse in 29 SMSAs (Standard Metropolitan Statistical Areas) and national monitoring of abuse trends, including detection of new abuse entities and new combinations.

3. Provision of current data for the assessment of the relative hazards to health, both physiological and psychological, and relative abuse potential for substances in human experience.

4. Provision of data needed for rational control and scheduling of drugs of abuse, both old and new.

The DAWN project was conceived originally by the Drug Enforcement Administration as "the hub of a total early warning system incorporating other types of intelligence data" (2a). After DAWN's inception in September 1972, the Special Action Office for Drug Abuse Prevention in the Executive

Office of the President became interested in the project, and joint funding was arranged for the second phase, beginning in April 1973. Subsequently, the National Institute on Drug Abuse assumed the funding role of the Special Action Office, with the plan that the DAWN project serve the data needs of both these agencies, as well as the Drug Enforcement Administration.

Data are reported to DAWN on episodes of drug abuse by four types of facilities (1b): emergency rooms in non-Federal short-term general hospitals (as defined by the American Hospital Association), inpatient units of these hospitals, offices of medical examiners or coroners, and crisis intervention centers.

The terms used in the project were defined as follows (1c):

Tearsheet requests to Dr. Philip H. Person, Chief, Forecasting Branch, Division of Resource Development, National Institute on Drug Abuse, Rockwall Bldg., Rm. 618, 11400 Rockville Pike, Rockville, Md. 20852.

1. *Drug abuse* was defined as the non-medical use of a substance for any of the following reasons: psychic effect, dependence, or self destructon. For purposes of this definition, non-medical use means:

a. The use of prescription drugs in a manner inconsistent with accepted medical practice.

b. The use of OTC (over-the-counter) drugs contrary to approved labeling.

c. The use of any other substance (heroin, marijuana, peyote, glue, aerosols, etc.).

2. *A drug-related death* was defined as:

a. Any death involving a drug 'over-dose' where a toxic level is found or suspected.

b. Any death where the drug usage is a contributory factor, but not the sole cause, i.e., accidents, diseased state, withdrawal syndrome, etc.

The original DAWN plan required the use of 64 sets of facilities in 38 cities to represent the 13 Drug Enforcement Administration regional areas in the United States. A facility set included a general hospital, a medical examiner, and a crisis center. The hospitals were selected according to a random design; the medical examiners were covered 100 percent; and the crisis centers were purposively chosen from existing partial lists of the centers (2b).

The coverage was changed for the second phase of the project, which began in April 1973 (1d). The new plan called for 100 percent coverage for medical examiners (MEs) in 23 cities, 100 percent coverage for hospital emergency rooms (ERs) in 20 of the 23 cities and sampling in the other 3, continuation of reporting from the selected inpatient units and crisis centers in the 23 cities from the first phase of the project, and continuation of the original limited coverage in 6 more cities. Reporting was discontinued in the remainder of the original 38 cities. To provide ER and ME data that could be projected nationwide, a national panel (a stratified random sample outside the 23 cities) was created (1e).

Cities were defined as SMSAs as specified for the 1970 U.S. Census of Population (3). The 23 SMSAs

included in the second phase of the project were:

Atlanta	New Orleans
Boston	New York
Buffalo	Oklahoma City
Chicago	Omaha
Cleveland	Philadelphia
Dallas	Phoenix
Denver	Raleigh
Detroit	San Antonio
Indianapolis	San Francisco
Los Angeles	Seattle
Miami	Washington, D.C.
Minneapolis	

One hundred percent coverage of ERs was attempted in all of these SMSAs except Chicago, Los Angeles, and New York, where random samples were drawn. The inpatient units were located in hospitals where the ER was already in the system, and the crisis centers were in the same cities (1f).

The data collected in the DAWN system are based on episodes. Information is reported about the circumstances of the episode and the drug, or drugs, associated with it. As many as six drugs or substances can be mentioned for each episode. In addition, information is given about the person involved, but the person is never identified by name to the DAWN system. Hence, since persons are not identified and since data are reported by several facilities in the same city, it is possible, even likely, that persons appear more than once in the DAWN system. Indeed, a person could be reported more than once within the same facility.

The meaning of episode is different for each type of facility. Although the episodes are all within the definition of a drug abuse crisis or drug-related death, the nature of the facility has much to do with the character of the episode. An ER episode is a drug emergency that appears to require immediate medical intervention. An inpatient unit episode may be a detoxification treatment, or it may be continued emergency treatment, since an emergency room episode may lead to an inpatient admission. An ME episode is a drug-related death, perhaps the

outcome of an unresolved drug emergency. Crisis center episodes are a mixture of outpatient treatment visits, "hotline" telephone calls, and walk-in, self-perceived crises that may or may not be as urgent as emergency room episodes.

Data-Collecting Process

The entire DAWN data-collecting system is operated on contract by IMS America, Ltd., Ambler, Pa. A member of the firm's field staff recruits the necessary facilities and trains the DAWN reporters. The objective, of course, is for all reporters to use the same definitions and procedures. All diagnostic decisions are expected to be made by appropriate medical staff.

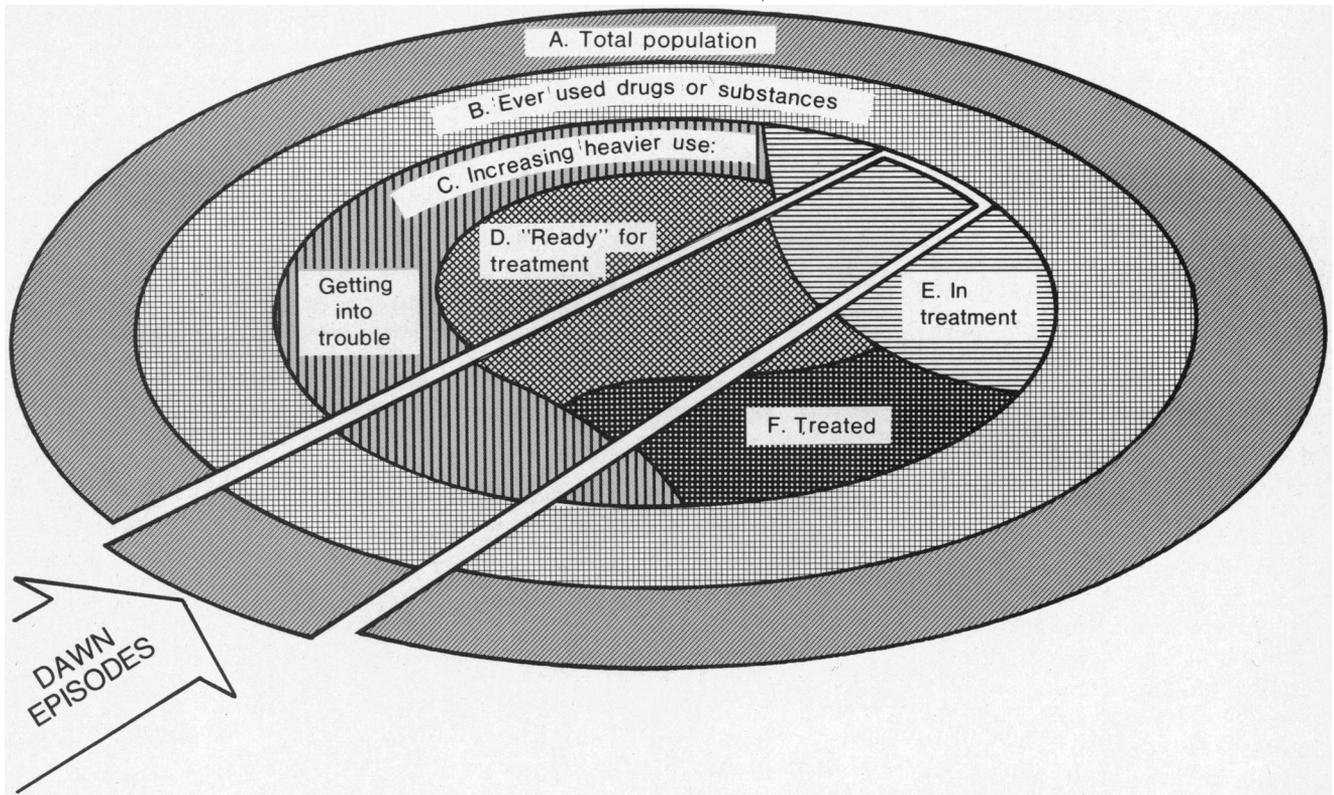
The episode reports are completed and sent to the contractor. Data editors then review each report, query for missing data, and maintain at least monthly contact by telephone with each of their assigned facilities. When the forms have passed the first processing stage, they are coded and key-punched. Throughout the subsequent handling of the data, additional checks are made by many computer edits, resulting in a high degree of error control in the data-processing system.

Population at Risk

Any population—of an SMSA for example—comprises several classes of persons with respect to drug use, as shown in figure 1. The numbers in each group are unknown, and the lines between the groups are not always sharp. Of the total population, represented by area A, some portion is included in area B because they have used some drug or substance in a way defined as drug abuse. This group includes all experimenters, self-medicators, and self-prescribers, as well as heavy users and addicts.

Area C includes persons whose use of drugs is becoming heavier or more frequent. These persons are becoming more and more psychologically dependent on drugs and may be developing a physiological addiction. They also will be getting

Figure 1. Drug use in a population



into trouble because of their drug use, although they probably will not recognize it or admit it. The number of people in area C is certainly smaller than the number in area B, but it is probably larger than might be generally expected because of the denial symptom associated with drug dependency or addiction, especially in the early stages.

Area D includes persons whose drug use has brought about a readiness for treatment, and area E represents those who are actually in treatment. A person may be in one of these groups because he has reached a point at which he feels that physically, mentally, and emotionally he has no choice but to seek treatment; that is, he has hit "bottom," so to speak. Others who have not reached this "bottom" stage, however, are also in these groups, because they have been forced into treatment by an outside authority, such as parents, a spouse, an employer, the school, or the law.

Thus, these groups are not as homogeneous as they might appear. The final category, area F, comprises persons who have been treated but are no longer in treatment.

Although theoretically DAWN could not draw from area A, figure 1 allows for such an event because of problems in applying the definition of drug abuse. The population represented in the DAWN system thus includes a wide range of drug users: fully addicted heroin users, experimenters with LSD or other drugs, dependent barbiturate users, tranquilizer users who, knowingly or not, potentiate the drug with alcohol or other sedatives, and users of self-prescribed medications.

Uses of DAWN Data

The episode reports collected by DAWN provide data that have intrinsic meaning. In an SMSA in which emergency rooms are covered 100 percent, for example, the ER data may be considered descriptive

of the drug emergencies that occurred in that SMSA. Thus, there can be little doubt about the "face validity" of these data. DAWN data are also considered useful as indicators of drug abuse, and herein lies a difficult problem of definition. The problem is really twofold, one part having to do with the concept of an indicator and the other involving the definition of the entity the indicator is assumed to measure.

Concept of indicator. Use of the term "indicator" seems to have arisen from its meaning as a dial or gauge that portrays the actual state of an entity, such as an elevator location dial or a barometer. This concept has been broadened in its application to the characteristics of human populations. Figure 2 shows three conditions in which observations are sometimes called indicators. The third condition, R_s , is the one of interest here.

The unmeasurable entity R_s is

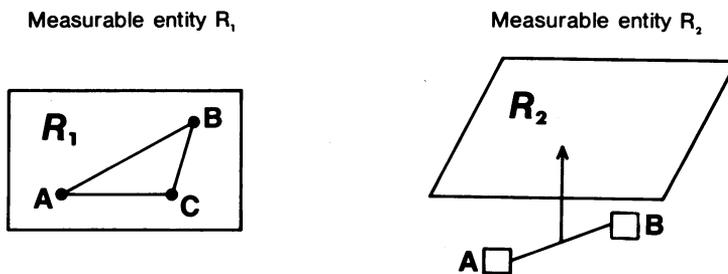
drug abuse in a human population. It could be measured precisely if a set of symptoms could be agreed upon and each person, or a representative sample of the population, could be observed, queried, or examined sufficiently to establish the presence or absence of the symptoms. Agreement on symptoms and confirmation of them in a population sample appear impossible at present. Therefore, the entity R_3 is considered unmeasurable as a practical matter. However, a real entity called "drug-abusing people in a given population" does exist, and the size of this group and of its various parts and the increases or decreases in the size over time are of concern.

Since direct measurements of drug abuse do not exist, measures are used that are generally accepted as indicative of whether the problem is increasing or decreasing, even though they are not used as measures of absolute size. Changes in such indicators are believed to correspond directly to changes in the problem, and confidence is gained in their validity when several indicators are consistent.

DAWN data as indicators. DAWN provides such indicators of drug abuse. Data obtained by counting and characterizing the episodes occurring in emergency rooms, for example, may be taken as indicative of whether drug abuse is decreasing or increasing in a particular area or population group, on the assumption that the episodes occur to people who would be identified as drug abusers and that the occurrence of the episodes is directly related to the extent of drug use in the population. It will take further methodological work, however, to establish a quantitative relationship which would allow a statement such as: one ER episode multiplied by inflation factor equals x drug-abusing persons in the population.

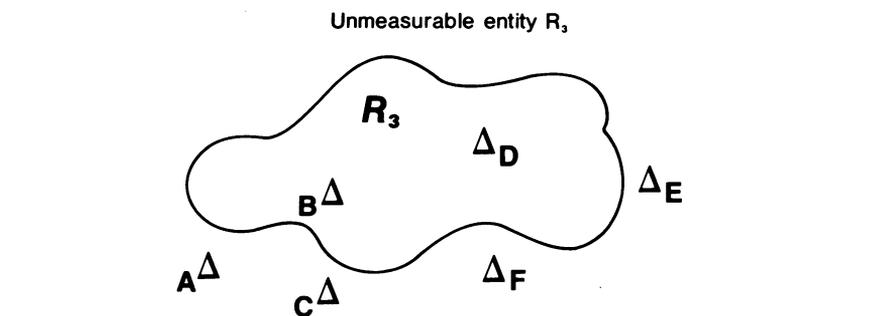
Despite limitations, the DAWN data do allow certain valuable analyses and can provide certain hypotheses. It seems reasonable to believe,

Figure 2. Indicator logic



A, B, and C (part of the measurable entity R_1) may be considered indicators of R_1 . They could be validated by measuring R_1 . This concept underlies sampling theory. (ABC) could be established as a composite index of R_1 .

A and B, though not part of the measurable entity R_2 , are highly correlated with it, and the correlation could be validated by actually measuring R_2 and relating it to A and B.



A, B, C, D, E, and F can be taken as indicators of the real but unmeasurable entity R_3 . They cannot be validated since R_3 cannot be measured. To the extent that they can be related theoretically and logically to R_3 , greater or lesser confidence can be placed in their descriptive ability. The extent to which they correlate with each other also affects confidence in them as valid indicators of the unmeasurable reality. NOTE: The unmeasurableness of R_3 may represent only a practical limit, not a logically impossible one.

for example, that as the level of a drug changes, the number of ER episodes related to that drug will reflect at least the direction, if not the amount, of change. It also seems likely that if drug strength is related to the drug emergency, a change in strength would be reflected by a corresponding shift in ER or ME episodes. Of course, there are confounding factors such as the toxicity of diluents used to cut such drugs as heroin, cocaine, and marijuana.

ER and ME data do not deal well with certain other aspects of drug use. They do not, for example, indicate whether a decrease in one drug is the result of a shift to another drug. Nor do the episode reports necessarily reveal the presence or

absence of addiction or dependency, particularly when there are no readily identifiable signs of these states.

Care in interpretation is also required in analyzing episodes in which several drugs are mentioned. One cannot extrapolate from multiple-drug mentions in ER or ME episodes to drug-use patterns in the changing, progressive development of drug dependence. Although drug combinations do occur with predictability, projecting a longitudinal development from a cross-section view is risky.

The DAWN data from inpatient units and crisis centers have these same limitations, plus other problems of interpretation as well. To

simplify the discussion, the remainder of this paper is therefore confined to considerations of ER and ME data.

Episodes and drug mentions. The DAWN data can be expressed for each SMSA or nationally in terms of either episodes or drug mentions. An episode is a drug-related death, for an ME, or a visit to an ER. A drug mention is the report of a drug associated with an episode. If four drugs were reported for one episode, for instance, four drug mentions would be reported. Use of the episode as the counting unit poses a difficult classification problem for cases in which two or more drugs are mentioned. Therefore, the drug mention is used as the counting unit for most of the data tabulations. The data indicate that the average number of drug mentions per episode is 1.4 for ERs and 1.5 for MEs (1f).

Typical Analyses

The drug-mention data are most useful for drug-specific analyses. An example of such data is presented in table 1. Percentage distributions of these data show that heroin accounted for 10.5 percent of the drug mentions in SMSA 1, but for only 6.6 percent in SMSA 2. For tranquilizers, the percentages were 19.5 in SMSA 1 and 21.9 in SMSA 2. That is, heroin mentions were proportionally more frequent in SMSA 1 than in SMSA 2, but the relative frequencies for tranquilizers were nearly the same. These data, however, cannot be taken to mean that heroin is a greater problem in SMSA 1 than in SMSA 2 or that tranquilizers are an equal problem because they do not take into account the size of the population in these two SMSAs.

An extension of the relative frequency measure is illustrated in figures 3 and 4. The large panels show two data series for each SMSA: all drug mentions reported by ERs and the sum of the mentions for selected drug categories. As an analytical device, consider that the area under the lines labeled "Sum of selected

Table 1. Number of mentions reported by emergency rooms for selected drug categories in two SMSAs, July 1973–September 1974

Drug categories	SMSA 1	SMSA 2
All mentions	17,055	7,583
Heroin	1,794	497
Methadone	400	219
Cocaine	132	31
Amphetamines	235	173
Barbiturates	855	1,028
Tranquilizers	3,331	1,659
Alcohol in combination	1,369	726
Methaqualone	203	143
Marijuana	327	71
Hashish	1,076	57
LSD	216	199
PCP	272	28
D-propoxyphene	347	157
Aspirin	789	328
All other	3,567	1,805
Drug unknown	2,142	462

Figure 3. Number of mentions reported by emergency rooms, all drugs and selected drug categories, SMSA 1, by month, July 1973–September 1974

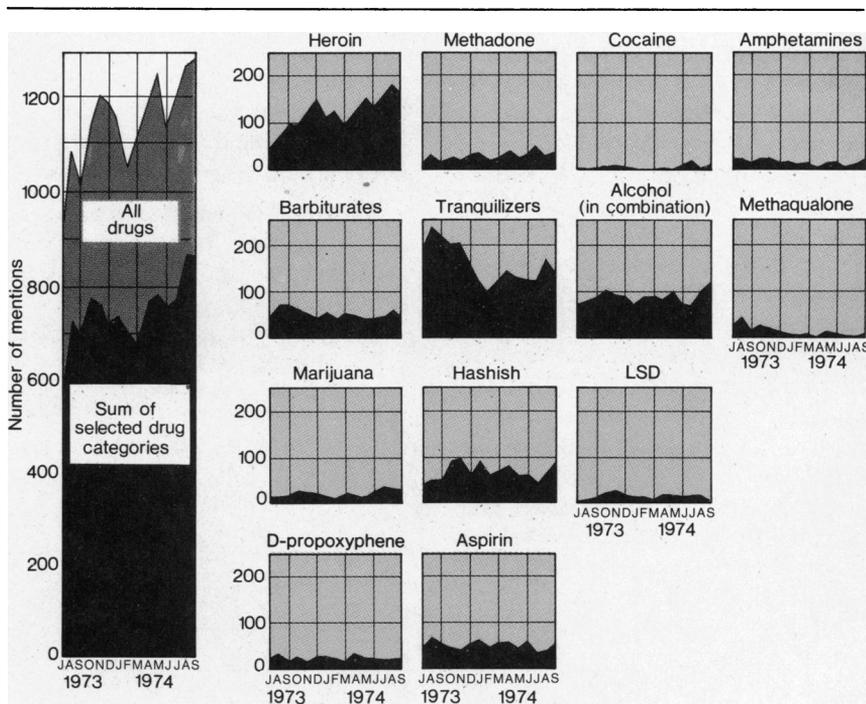
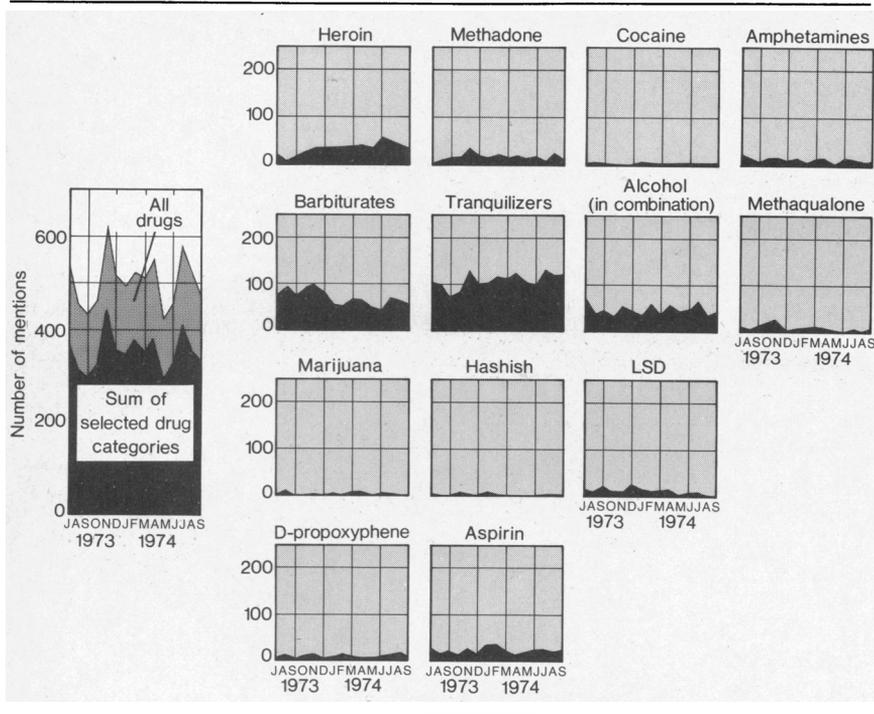


Figure 4. Number of mentions reported by emergency rooms, all drugs and selected drug categories, SMSA 2, by month, July 1973–September 1974



drug categories” is 100 percent. Then the smaller panels show two features: a time series for each drug category and the relative proportion of the total over time accounted for by the drug category. These two features can be compared between SMSAs, but, again, the severity of a particular drug problem cannot be compared because the data are not adjusted for population size.

The analysis for the two SMSAs suggests that the number of drug emergencies is increasing in SMSA 1 and that the number is stable in SMSA 2 but the type of drug is variable. In SMSA 1, the drug groups that contribute the most to the total are heroin (rising), tranquilizers (falling), and barbiturates, alcohol in combination with another drug, hashish, and aspirin (all stable). In SMSA 2, the drugs that contribute the most to the total are heroin and tranquilizers (both rising slightly) and barbiturates and alcohol in combination (both more or less stable). However, no adjustments were made in these data for variations in completeness of report-

ing; hence, monthly changes could be attributable to large hospitals entering or leaving the system. Although the DAWN plan called for inclusion of all ERs in an SMSA, this objective was in fact never attained. Striking increases or decreases in drug mentions should therefore be viewed in relation to the completeness of reporting, a feature planned for reports of DAWN data (4).

Relative frequency statistics may signify the need for attention to a particular locale. For comparisons between SMSAs, however, it is better to relate the data to the size of

the population. Such a ratio gives a measure of the severity of the problem in terms of how much of the population is affected. Thus, to determine whether or not heroin is a greater problem in SMSA 1 than in SMSA 2 or whether tranquilizers constitute equal problems in the two SMSAs, ratios of drug mentions to population may be calculated, as shown in table 2. The ratios for heroin mentions indicate that heroin is a greater problem in SMSA 1, as did the frequency data. The ratios for tranquilizers, on the other hand, suggest that these drugs are also a greater problem in SMSA 1, rather than an equal problem as indicated by the analysis of proportions.

Analysis of multiple-drug mentions presents a more difficult problem, since there are two possible counting units, drug mentions and episodes. However, some patterns may be identified by the type of presentation shown in figure 5. When mentioned in combination with other drugs, methadone was most frequently reported in combination with another single drug: heroin, alcohol, or barbiturates.

The project’s title, “Drug Abuse Warning Network,” implies that data from the system are to be used to alert someone to some potential event. As a practical matter, it would seem that a particular emergency room would become aware of shifts in drug-use patterns in its own community very quickly and reports from a large data-collecting system such as DAWN would be far too late to be useful. Thus, the “early warning” for an individual facility may appropriately come from the

Table 2. Ratio of drug mentions to population in two SMSAs

Area	Population	Heroin		Tranquillizers	
		Number of mentions	Ratio per 100,000 population	Number of mentions	Ratio per 100,000 population
SMSA 1	4,200,000	1,794	42.7	3,331	79.3
SMSA 2	2,754,000	497	18.0	1,659	60.2

data collected by that facility rather than from a report provided by DAWN. However, DAWN data may suggest a trend or indicate a developing problem that would not otherwise be observed, especially if there is no regular communication between emergency rooms in a community. For example, the data given in figure 3 suggest a definite increase in heroin mentions and a slight increase in methadone for SMSA 1. Just as important, they also indicate that tranquilizers and methaqualone are declining. No startling trends are apparent in figure 4 for SMSA 2, but the slight shifts for heroin and LSD might bear watching. Such shifts do not necessarily mean increasing or decreasing "drug problems," but they are events to be examined.

Statistical Limitations

Some statistical limitations of the DAWN data have been noted in

connection with the uses of the data. This section provides a more complete description of the limitations and their implications.

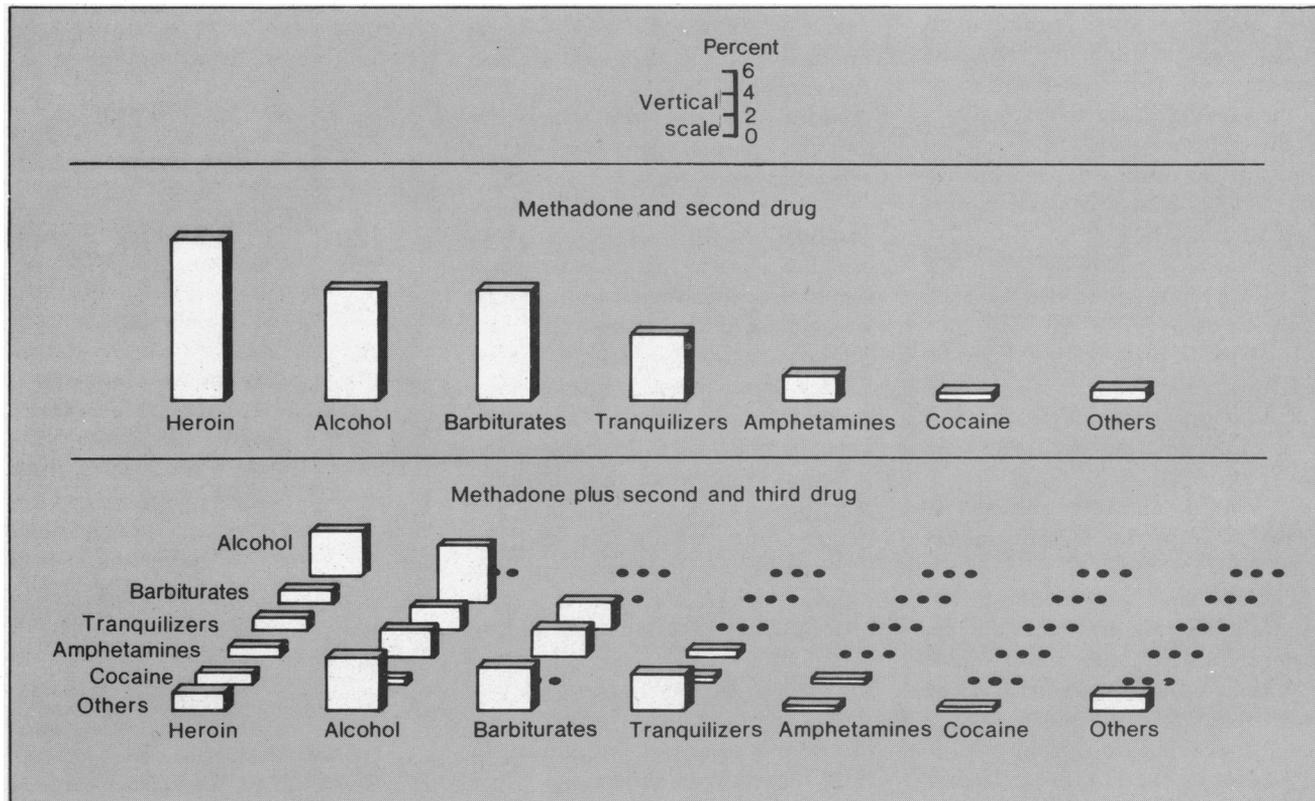
Coverage plan. DAWN was intended as a data system with several types of coverage, as previously described. Although it includes a random sample of ERs and MEs drawn from outside the selected SMSAs, the data cannot be pushed too far in making statements about the nationwide increase or decrease of drug use, abuse, addiction, dependency, or the "drug problem." Furthermore, the real interest is centered on data for specific SMSAs, since drug-use patterns appear to be peculiar to localities. Thus, as a practical matter, the DAWN data may be used most advantageously for specific SMSAs.

Level of reporting. All ERs in 20 SMSAs were to be covered in DAWN, but for various reasons the

coverage has been somewhat less than 100 percent. Overall coverage was 89 percent, with a variation from 66 to 100 percent among the SMSAs. In all but 2 SMSAs at least 80 percent of the ERs were included, and in 13 SMSAs 90 percent or more were covered (*1h*). A further complication arises, however, because some facilities leave the system and others enter. Therefore, while the participation rate may be 88 percent, for example, the participating group may not always include the same ERs. The size of the hospitals leaving or entering the system may affect the data.

As a crude measure, the ER data collected by DAWN are certainly indicative of trends within SMSAs in drug emergencies for large classes or groups of drugs, particularly since the possible error introduced by underreporting works in a conservative direction. Reports from nonreporting ERs would serve only to in-

Figure 5. Percentage distribution of 1,461 episodes of methadone in combination with other drugs reported by emergency rooms, July 1973–July 1974



crease the number of drug mentions. At worst, incomplete reporting might indicate a trend or a developing problem where there actually is no real change. However, for best use of the DAWN data, reporting levels should be specified when drawing inferences.

As a data system that reveals reliably the use of specific drugs or substances occurring at very low frequencies—say 0.1 to 0.5 percent of the mentions—the completeness of coverage becomes of more concern. To be certain that an event occurring at this level has not been missed, it is more important to know about the ERs that failed to report. Was their size or location such that their absence from the system could seriously affect the conclusion that might be drawn from the reported data? Even more elusively, do the missing ERs have policies that might exclude the type of drug-abuse cases in question?

Reliability and validity. The questions of reliability and validity arise in any data-collecting project. Reliability is the characteristic that assures that the same measurement would be made under the same circumstances by different observers or by the same observer twice. Validity is the characteristic that assures that the measurement or observation actually measures what it purports to measure.

Evaluating reliability in the DAWN system gives rise to such questions as:

1. Are all drug-related episodes in ERs identified?
2. Is appropriate judgment exercised in abstracting data from an ER record?
3. Would another trained reporter fill out the episode report form the same way?

The best that can be done to obtain reliability is to train the reporters carefully, use standardized definitions and procedures, and make reasonable checks to assure that instructions are carried out.

Validity in the DAWN project is concerned with whether the re-

ported drug was really the one taken. There may be doubt about a patient's truthfulness in reporting the drugs associated with an episode, and there is no practical way to verify the patient's statements other than by medical observation, the statements of others, or laboratory tests. Laboratory tests of body fluids and tissues are made for many ME episodes but rarely for ER episodes. Furthermore, the more specificity required the more difficult the validity problem; for example, identifying diazepam as a particular tranquilizer or distinguishing phenobarbital from pentobarbital. It is unlikely that complete accuracy could be obtained even with much additional questioning of the patient and laboratory testing. Therefore, it seems best to confine statements to those in which certainty is not required. After all, since the DAWN project is basically descriptive, only enough information is needed to decide to take action, or not, or to investigate the matter further.

Although not a validity factor in the same sense, the question of the "validity" of the DAWN data as indicative of the drug-abuse situation must also be kept in mind. This question was discussed previously, and the considerations need not be repeated.

Implications. Intra-SMSA analyses are all subject to the limitations just mentioned, and their results should not be extended beyond the data system's capability. Making inter-SMSA comparisons requires even more caution. Comparing percentage distributions is legitimate, but it does no more than show the relative frequency of mentions of a particular drug among the SMSAs. The number of mentions (or episodes) must be expressed as a ratio to the SMSA population for appropriate inter-SMSA comparisons of the severity of a drug problem.

For comparisons of severity, the first step is to adjust the number of drug mentions to reflect the entire area under consideration. Underre-

porting is the main problem here. In addition, the SMSAs must be examined for changes in boundaries, population size, the number of facilities, and the number that reported data. When the entire SMSA is considered, internal changes are not so likely to affect the data as when a smaller area is used. An urban renewal project or a housing development would have strong effect on the population of a relatively small area, but a lesser effect on the entire SMSA population. Analysis of SMSA data ought really to include consideration of relative exposure to risk in various parts of the SMSA. Are some hospital ERs more likely than others to receive certain types of cases? Because of policy? Or because of the population served?

These considerations are all important in presenting and using the data provided by DAWN. If not extended too far and if used with the necessary caveats, DAWN information can be helpful in reaching decisions, at least about a given population of events. When coupled with other information, the DAWN data become even more powerful and the decisions more firmly grounded.

References

1. U.S. Department of Justice, Drug Enforcement Administration: DAWN 2 analysis, July 1973–March 1974. U.S. Government Printing Office, Washington, D.C., 1974, (a) p. i, (b) p. iv, (c) p. ii, (d) pp. ii–iii, (e) pp. vi–xii, (f) pp. v–vii, (g) p. 2, (h) p. vii.
2. U.S. Department of Justice, Drug Enforcement Administration: DAWN 1 analysis, September 1972–April 1973. U.S. Government Printing Office, Washington, D.C., 1974, (a) p. ii, (b) pp. vi–viii.
3. U.S. Bureau of the Census: Statistical abstract of the United States, 1972. U.S. Government Printing Office, Washington, D.C., 1972, pp. 898–902.
4. U.S. National Institute on Drug Abuse: DAWN city summaries. DHEW Publication No. (ADM) 76–235. U.S. Government Printing Office, Washington, D.C., 1975.